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Convertible Vehicle

The invention relates to a convertible vehicle with at least one flexible roof area that can also comprise essentially the entire roof according to the preamble of Claim 1 and according to the preamble of Claim 6.

DE 101 40 232 A1 shows a convertible vehicle with a rigid rear roof part and a flexible roof area on it that follows in driving direction, which comprises a roof covering held from below by several transverse hoops. The transverse hoops are connected to each other in a known way by way of lateral frame parts. For opening the flexible roof area, these frame parts are swiveled with respect to each other around vertical axes. This is done by several drives arranged on the respective longitudinal sides of the vehicle. In order to ensure a uniform shortening of the roof area in the opening phase, these must be synchronized with each other, which is complicated. In addition, the folding mechanism of the lateral frame parts that is shown is complicated and additional measures must be taken in order to avoid uncontrolled folding of the roof covering and its jamming in the link areas.

US 1 799 050 shows a vehicle with a roof area supported by several transverse hoops 21, 23, whereby for opening the roof, the front transverse hoop

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23 can be moved backward during roof opening and to do this, lateral longitudinal guiding aids (pipe 22 that can be inserted) are assigned to it for cooperation with a longitudinal guiding projection 20 (sleeve for holding the pipe that can be inserted) of the hoop 23 lying behind it.

A design such as this is only suitable for vehicles, in which exactly two hoops have to be moved with respect to each other. The second hoop already has to be slid below with respect to a third hoop 17 and folded down, the other hoop 17 is folded around the lower swivel link 16 with respect to the rear hoop 26.

The invention is based on the problem of optimizing a convertible vehicle of the type named with respect to the opening kinematics with shortening of the roof that is supported by more than two hoops. .

The invention solves this problem by a convertible vehicle with the characteristics of Claim 1 and by a convertible vehicle with the characteristics of Claim 6, which can be implemented individually or in combination with each other. Advantageous designs of the object of the invention will be found in the other Claims 2 to 5 and 7 to 16.

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The design according to Claim 1 in the invention causes a mechanical controlled longitudinal guidance of the flexible roof area. Therefore, a case is prevented, in which opposite longitudinal side areas are moved backward at different speeds during opening and can make the roof area crooked. During the opening movement, the transverse hoops are thus also parallel to each other at all times without synchronizing measures. Lateral rod parts can be dispensed with so that there is a lot of head room and shoulder room even during the roof movement so that a large amount of head and shoulder room results, even during the roof movement. Due to the lateral offset of longitudinal guiding aids and/or projections of successive hops, a number of such hoops can be provided to support the roof surface, all of which can be moved with respect to each other in the same way. Therefore these can be formed so that they are long and do not require any connection to links in the area of the apron wall line, but can lie e.g. completely above the side windows. In this case, the longitudinal guiding projections and/or aids can be designed in the same way, which makes manufacturing easier.

Because of an advantageous engagement with each other of longitudinal guiding aids and longitudinal guiding projections – even with the roof closed – a procedure for threading the parts can be dispensed with. The roof opening is thereby accelerated.

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In particular, if a rigid rear roof part is provided, the front of which connects with the flexible roof area, the opening can be further accelerated if during the lowering of the rigid roof part, the shortening movement of the front, flexible roof area takes place simultaneously.

When the guiding aids and guiding projections of the drive are completely decoupled, the design is additionally simplified.

In this case, a single element, e.g. a hydraulic cylinder, can be adequate if it provides the driving force by way of a slidable lattice gate lying in the longitudinal center plane on the flexible roof area. Because of the combination that is not mandatory, but advantageous, the parallel movement of both longitudinal sides is ensured with the longitudinal guiding projections and the longitudinal guiding aids, even without lateral frame parts, in spite of only having a center drive. In any case, when the drive is implemented using the central slidable lattice gate, the head room and shoulder room are increased since lateral parts of the drive kinematics are not present which especially lead to restrictions in space during the movement of the roof.

Other advantages and characteristics of the invention will be found from an embodiment example shown in the drawing and described in the

following of the object of the invention.

The following are shown in the drawings:

Fig. 1 a schematic perspective cutaway view of a convertible vehicle according to the invention with closed roof with a roof covering that is shown semi-transparent for the sake of clarity,

Fig. 2 a view similar to Fig. 1 while the roof is being opened with rigid roof part and shortening flexible roof area that swivel downward simultaneously during the roof opening,

Fig. 3 a view similar to Fig. 2 with a further progressed roof opening and/or in the early phase of the roof closing,

Fig. 4 a similar view to Fig. 3 with a further progressed roof opening and/or in the early phase of the roof closing,

Fig. 5 a side view toward the completely opened roof, i.e. from the direction of arrow V in Fig. 4.

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The upper and center area of convertible vehicle 1 according to the invention, which comprises the passenger compartment 2, is shown schematically in Fig. 1. This can be covered by a movable roof 3 that is closed according to the illustration in Fig. 1.

In the embodiment example, the roof 3 comprises a rigid rear roof part 4, which in this case comprises a dome-like rear window 5 which can be provided outside a center viewing area with a dark, light and/or heat-absorbent coating. This is connected to the body 6 by way of lateral main bearings 7 so that it can move and can be stored completely in the body below an apron wall 8. To swivel the rear roof part 4 around the main bearing 7, lateral driving elements 9 are used if an automatic roof opening and closing will be implemented.

When the roof is closed (Fig. 1) a flexible roof area that is designated with 10 overall is connected to the rigid roof part 4 in driving direction F. This comprises a covering 11 made, for example, of textile or plastic that is shown so that it is transparent in Fig. 1 for the sake of visibility. Because of this, several transverse hoops 12, 13, 14, 15, 16 that support the covering 11 are visible. In this case, the front hoop 12 forms the so-called

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roof peak, which is locked with the windshield frame 17 when the roof 3 is closed.

A slidable lattice grate 18 that lies centrally and symmetrically to the vertical vehicle longitudinal center plane 21 also engages under covering 11. This is connected, at least, to the front transverse hoop 12. The slidable lattice grate 18 lies in the extension plane of the flexible roof area 10 and has a number of swivel axes 19 that are perpendicular to it around which the individual control arms 20 of the slidable lattice gate can be swiveled in and out.

Because of the position in the extension plane of the roof 3, a minimum and flat stowing dimension for the folded slidable lattice gate 18 results when the roof is open. Because of the central arrangement of the slidable lattice gate 18 lying in the longitudinal center plane, it lies centrally in an area in which no rod parts 19 or drive parts 9 connected to the main bearing 7 lie even when the roof 3 is open. In addition, head room and shoulder room are significantly increased because of the central arrangement. Lateral frame parts for a drive of the roof folding movement can be dispensed with completely.

At intersection points 22 of the control arms 20, these are connected to transverse hoops 13, 14, 15 lying behind the roof peak 12, which is not absolutely necessary. Because of the connection with all of the hoops,

however, during opening the spaces between them can be reduced uniformly since they are all pulled backward around axis 19 when the control arm 20 is swiveled in.

On the transverse hoops 13, 14, 15, the flexible roof area comprises two longitudinal guiding aids 23, 24, 25 and two longitudinal guiding projections 27, 28, 29 on both sides of the vertical longitudinal center plane 21 and symmetrical to it. In addition, the front hoop 12 has two longitudinal guiding projections 30, and additionally two longitudinal guiding aids 26 are arranged behind the most rearward hoop 16. The latter-named are connected to the control arms 19 of the swiveling mechanism for the rear rigid roof part 4.

The longitudinal guiding projections 27, 28, 29, 30 are designed as dimensionally stable pipe sections and in top view extend approximately parallel to the vehicle longitudinal direction, whereby a slight angling would also be possible here. With respect to the horizontal, they are either set slightly diagonally according to the roof curvature and/or bent inward, which has an especially positive visual effect on short roofs with great curvature.

The longitudinal guiding aids 23, 24, 25, 26 are also dimensionally stable and comprise sleeve elements, each of which are angled according to the roof curvature and each engaged in longitudinal guiding projections 27,

28, 29, 30. The width of the respective sleeve is dimensioned in such a way that they tightly engage with the longitudinal guiding projections 23, 24, 25, 26 but make possible a relative movement of the parts with respect to each other parallel to the extension of the longitudinal projections 23, 24, 25, 26. In the embodiment example, the engagement position of the parts exists not only when the roof is moving or open, but also when the roof is closed so no special measures have to be provided for central threading.

By way of the longitudinal guiding aids 23, 24, 25, 26 and longitudinal guiding projections 27, 28, 29, 30, no drive force has to be provided so no synchronization is necessary even during movement of the roof sides. The introduction of force occurs only by way of the slidable lattice grate that lies centrally and a central drive element 31 that swivels the control arm 20 around the axis 19.

In detail, the arrangement of longitudinal guiding aids 23, 24, 25, 26 and longitudinal guiding projections 27, 28, 29, 30 is as follows in the embodiment example shown:

At the roof peak 12, only two pipe pieces 30 are arranged symmetrically which point toward the back and engage in sleeves of the longitudinal

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guiding aids 23 of the adjacent hoop 13 toward the rear.

This has pipe pieces 27 that lie further outside with respect to the vertical vehicle longitudinal center plane 21 and also point backward as longitudinal guiding projections, which in turn engage in sleeves of the longitudinal guiding aids 24 of the adjacent hoop 14 that points backward.

This third transverse hoop also has pipe pieces 28 that lie further toward the outside with respect to the vertical vehicle longitudinal center plane 21 in comparison to its longitudinal guiding aids 24 as longitudinal guiding projections, which in turn engage in sleeves of the longitudinal guiding aids 25 of the adjacent hoop 15 toward the rear.

The relationships are repeated there: this one also has pipe pieces 29 that lie further outward with respect to the vertical longitudinal vehicle center plane 21 and also point toward the back as longitudinal guiding projections, which then engage below the rear hoop 16 without a connection and engage in longitudinal guiding aids 26 of a rear transverse control arm arrangement 32 that can move by way of control arm arrangement 19. The hoop 16 secures the connection of the cover material 11 on the rear roof part 4.

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Therefore, overall the longitudinal guiding projections 30, 27, 28, 29 of successive hoops 12, 13, 14, 15 are offset with respect to each other with respect to the vertical longitudinal center plane 21, namely in such a way that they are always arranged further outward from forward to back. Therefore, a collision of the pipe pieces is prevented even during the roof opening when roof area 10 is shortened.

However, simultaneously at each hoop 13, 14, 15 the longitudinal guiding aid 23, 24, 25 for the longitudinal guiding projections 30, 27, 28 of the next hoop in succession and of their own longitudinal guiding projections 27, 28, 29 are immediately adjacent so that the longitudinal guiding projections 27, 28, 29, 30 overall form a longitudinal frame for the roof area 10 and lie immediately adjacent to each other when roof 3 is open.

For opening the roof 3, from the beginning (transition from Figure 1 to Figure 2) both the rear roof part 4 is swiveled downward into the body 6 and the front roof area 10 is shortened and moved upwards so that at the end both roof parts 4, 10 lie below the same apron wall 8 (Fig. 5). The roof movement is considerably accelerated because of this combination of simultaneous movement sequences.

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Because of the vertical position of the front roof part 10 that is shown here during opening, when roof 3 is completely lowered, the longitudinal guiding projections 30, 27, 28, 29 lie essentially vertical and adjacent to each other (Fig. 5) so that a flat package with little height is formed due to the shortening, which can be placed e.g. behind the backrests of a seating row without great luggage compartment restrictions. The rear roof part 4 then lies over this package or slightly behind it under a luggage compartment lid and with its curvature that points outward needs only a little space.

Enclosure 3

The following opinion is given on the decision dated March 10, 2005:

I.

New Claims 1 to 16 are being submitted, connected with the request of placing these at the location of the previous Claims 1 to 17 for further examination.

The new Claim 1 is combined from the previous Claims 1 and 14 and now comprises the lateral offset of guiding aids of different hoops following each other in succession as well as the lateral displacement of corresponding guiding projections.

Claims 2 to 13 are unchanged. Claim 14 was canceled. The previous Claims 15 to 17 are included, moved back and with adjusted numbering, as new Claims 14 to 16.

The new claims are thus originally disclosed by the previous claims.

II.

Regarding novelty and inventive activity:

Claim 1 is novel in comparison to D1 in that the longitudinal guiding projections point in the direction of the longitudinal guiding aids. The holding of the lateral offset of longitudinal guiding aids and projections of successive hoops forms a new characteristic. The present Claim 1 is also based on inventive activity:

US 1 799 050 A (document D1) shows a vehicle with a roof area supported by way of several transverse hoops 21, 23, whereby for opening the roof, the front transverse hoop 23 can be moved backward during roof opening and for this purpose lateral longitudinal

guiding aids (sliding tube 22) are assigned to it for cooperation with a longitudinal guiding projection 20 (sleeve for holding the sliding tube) of the hoop 23 lying behind it.

A design such as this is only suitable for vehicles in which exactly two hoops are to be moved with respect to each other. A third hoop 17 would have to be moved differently with respect to the rear hoop 26, in this case by folding it down around the lower swivel link 16.

In contrast, the invention is based on the problem of designing more than two hoops that can move longitudinally with respect to each other to shorten the supported roof surface.

The invention solves this by the lateral offset of longitudinal guiding aids and longitudinal guiding projections of successive transverse hoops. Only in this way is it possible to move more than one hoop back with respect to the vehicle longitudinal direction and to approach a successive hoop without there being a collision of the longitudinal guiding aids or projections of several hoops. However, to do this D1 was able to offer the suggestion, since a total of four hoops are present of which only the forward-most can be moved longitudinally with respect to the second one. The document teaches that for the other hoops other movement possibilities will have to be found: for example, the second hoop is moved downward with respect to the third and at the same time swiveled in. The third hoop folds down completely around the lower-lying link. However, this only works if at least the third and fourth hoop are held at about the height of an apron wall line, so that the swivel link can also be located here. For a roof surface that lies above the side windows and is connected to a rear roof part without its own contact to the apron wall line, as is possible in the vehicle designed according to the invention, D1 therefore cannot offer any suitable roof kinematics.

GB 448 720 A (document D2) shows a number of outer frame parts, each of which swivel with respect to each other around vertical axes in order for the hoops to approach each other. However, in this phase effective longitudinal guiding aids are not present. In this way, seen from above, during roof opening the hoops can come together at an angle, which is exactly what is prevented by the longitudinal guiding aids and longitudinal guiding projections according to the invention. Therefore, this document clearly lies further away from the invention applied for than opposing document D1.

A similar case also applies to DE 199 56 482 C2 (document D3). In this case, the diagonal position of the hoops in top view can already be seen in the illustration of the summary on page 1 of the patent document. Therefore, this document also lies further away than the opposing document 1.

Even a combination of D1 with D2 or D3 cannot make the invention obvious since in the two latter-named documents no longitudinal guiding aids are included and, therefore, the combinations of documents would not go beyond the teachings of D1 in this matter either.

III.

In addition, a new description is submitted that is adapted to the new claims and in which document D1 is acknowledged. It is requested that this description be used as the basis for further examination instead of the previous one.

IV.

It is requested that an examination report be ordered that basically recognizes the patent worthiness.

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New Claims:

1. Convertible vehicle (1) with at least one flexible roof area (10) supported by transverse hoops (12; 13; 14; 15; 16) lying in succession over its longitudinal course, which can be shortened for its opening by movement of transverse hoops (12; 13; 14; 15) with a movement component in vehicle longitudinal direction,

characterized in that

at least one transverse hoop (13; 14; 15) has a longitudinal guiding aid (23; 24; 25) assigned to it for cooperation with a longitudinal guiding projection (30; 27; 28) of another transverse hoop (12; 13; 14) pointing in its direction, whereby the longitudinal guiding aids (23; 24; 25) and the longitudinal guiding projections (30; 27; 28; 29) of successive transverse hoops (12; 13; 14; 15) are offset with respect to each other, relative to the vertical vehicle longitudinal center plane (21).

2. Convertible vehicle according to Claim 1,

characterized in that

one longitudinal guiding projection (30; 27; 28; 29) and one longitudinal guiding aid (23; 24; 25; 26) each have dimensionally stable parts that engage in each other and can move with respect to each other.

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3. Convertible vehicle according to Claim 2,
characterized in that
one engagement position exists both with closed and with open roof area (10).

4. Convertible vehicle according to one of Claims 1 to 3,
characterized in that
one longitudinal guiding projection (30; 27; 28; 29) and one longitudinal guiding aid (23; 24; 25; 26) are formed so that they are complementary to each other in the engagement area.

5. Convertible vehicle according to one of Claims 1 to 4,
characterized in that
the force for movement of the flexible roof section (10) can be provided independently of the longitudinal guiding aids (23; 24; 25; 26) and projections (30; 27; 28; 29).

6. Convertible vehicle (1) with at least one flexible roof area (10) supported over its longitudinal course by transverse hoops (12; 13; 14; 15; 16) lying in succession, which for its opening can be

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shortened by movement of transverse hoops (12; 13; 14; 15) with a movement component in vehicle longitudinal direction, especially according to one of Claims 1 to 5,

characterized in that

the force for movement of the flexible roof section can be introduced into it by way of a slidable lattice grate (18) lying in the extension plane of the flexible roof area (10) with swivel axes (19) lying perpendicular to the extension plane.

7. Convertible vehicle according to Claim 6,

characterized in that

the slidable lattice grate (18) is arranged centrally in the area of a longitudinal center plane (21) of roof (3) and can be moved by a single drive (31).

8. Convertible vehicle according to one of Claims 1 to 7,

characterized in that

a longitudinal guiding projection (30; 27; 28; 29) is designed as a pipe section with an extension component in vehicle longitudinal direction.

9. Convertible vehicle according to Claim 8,

characterized in that

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a longitudinal guiding projection (30; 27; 28; 29) is bent corresponding to the roof curvature.

10. Convertible vehicle according to one of Claims 8 or 9,
characterized in that
a longitudinal guiding aid (23; 24; 25; 26) comprises a pipe sleeve with extension components in the vehicle longitudinal direction.

11. Convertible vehicle according to Claim 10,
characterized in that
a longitudinal guiding aid (23; 24; 25; 26) is angled with respect to the horizontal corresponding to the roof curvature.

12. Convertible vehicle according to one of Claims 1 to 11,
characterized in that
a number of transverse hoops (12; 13; 14; 15; 16) is provided, to which at least one longitudinal guiding projection (27; 28; 29) and one longitudinal guiding aid (23; 24; 25) are assigned, except for the furthest forward (12) with respect to driving direction (F) and the one lying furthest to the rear (16).

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13. Convertible vehicle according to Claim 12,
characterized in that
in each case symmetrically to one vertical vehicle longitudinal center plane (21), two longitudinal guiding projections (27; 28; 29) and two longitudinal guiding aids (23; 24; 25) are assigned to each transverse hoop (13; 14; 15), except for the farthest toward the front (12) and the farthest toward the rear (16) with respect to vehicle driving direction (F).

14. Convertible vehicle according to one of Claims 1 to 13,
characterized in that
on each transverse hoop (13; 14; 15) provided with at least one longitudinal guiding aid (23; 24; 25) and at least one longitudinal guiding projection (27; 28; 29), the longitudinal guiding aid (23; 24; 25) and the longitudinal guiding projection (27; 28; 29) lie immediately adjacent to each other in vehicle transverse direction.

15. Convertible vehicle according to one of Claims 1 to 14,
characterized in that
it comprises a rigid rear roof part (4) surrounding a rear window

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(5) on which the flexible roof area (10) follows in driving direction (F) when the roof (3) is closed.

16. Convertible vehicle according to Claim 15,

characterized in that

the rear roof part (4) can be lowered into the body (6) during the shortening of the flexible roof area (10).

Enclosure 4

For the international preliminary report regarding patentability, a modified set of claims (*) was submitted as an enclosure, with a request to base the further procedure on them.

The current Claim 1 now comprises the original Claim 1 submitted, supplemented with the offset or the arrangements of several hoops lying in succession as is described in the three paragraphs on page 10 and the summarizing abstract at the top of page 11 of the original description. Claim 1 is thus originally disclosed.

The new Claim 6 is subordinate, whereby no new characteristics have been included in comparison to the original. Thus Claim 6 is also originally disclosed.

In comparison to the claims originally submitted, Claims 2 to 13 are unchanged. Claim 14 was canceled. The previous Claims 15 to 17 are included, moved back and with adjusted numbering, as new Claims 14 to 16.

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Claims:

1. Convertible vehicle (1) with at least one flexible roof area (10) supported by transverse hoops (12; 13; 14; 15; 16) lying in succession over its longitudinal course, which can be shortened in vehicle longitudinal direction with a movement component for opening by displacement of transverse hoops (12; 13; 14; 15),
characterized in that
at least one longitudinal guiding aid (23; 24; 25) is assigned to each of several transverse hoops (13; 14; 15) lying in succession for cooperation with a longitudinal guiding projection (30; 27; 28) of another transverse hoop (12; 13; 14) pointing in its direction, whereby the longitudinal guiding aids (23; 24; 25) and the longitudinal guiding projections (30; 27; 28; 29) of transverse hoops (12; 13; 14; 15) lying in succession are offset with respect to each other relative to the vertical vehicle longitudinal center plane (21).

2. Convertible vehicle according to Claim 1,
characterized in that
one longitudinal guiding projection (30; 27; 28; 29) and one longitudinal guiding aid (23; 24; 25; 26) each have dimensionally

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stable parts that engage in each other and can move with respect to each other.

3. Convertible vehicle according to Claim 2,
characterized in that
one engagement position exists both with closed and with open roof area (10).

4. Convertible vehicle according to one of Claims 1 to 3,
characterized in that
one longitudinal guiding projection (30; 27; 28; 29) and one longitudinal guiding aid (23; 24; 25; 26) are formed so that they are complementary to each other in the engagement area.

5. Convertible vehicle according to one of Claims 1 to 4,
characterized in that
the force for movement of the flexible roof section (10) can be provided independently of the longitudinal guiding aids (23; 24; 25; 26) and projections (30; 27; 28; 29).

6. Convertible vehicle (1) according to one of Claims 1 to 5,
characterized in that

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the force for movement of the flexible roof section can be introduced into it by way of a slidable lattice grate (18) lying in the extension plane of the flexible roof area (10) with swivel axes (19) lying perpendicular to the extension plane.

7. Convertible vehicle according to Claim 6,
characterized in that
the slidable lattice grate (18) is arranged centrally in the area of a longitudinal center plane (21) of roof (3) and can be moved by a single drive (31).

8. Convertible vehicle according to one of Claims 1 to 7,
characterized in that
a longitudinal guiding projection (30; 27; 28; 29) is designed as a pipe section with an extension component in vehicle longitudinal direction.

9. Convertible vehicle according to Claim 8,
characterized in that
a longitudinal guiding projection (30; 27; 28; 29) is bent corresponding to the roof curvature.

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10. Convertible vehicle according to one of Claims 8 or 9,
characterized in that
a longitudinal guiding aid (23; 24; 25; 26) comprises a pipe sleeve with extension components in the vehicle longitudinal direction.

11. Convertible vehicle according to Claim 10,
characterized in that
a longitudinal guiding aid (23; 24; 25; 26) is angled with respect to the horizontal corresponding to the roof curvature.

12. Convertible vehicle according to one of Claims 1 to 11,
characterized in that
a number of transverse hoops (12; 13; 14; 15; 16) is provided, to which at least one longitudinal guiding projection (27; 28; 29) and one longitudinal guiding aid (23; 24; 25) are assigned, except for the furthest forward (12) with respect to driving direction (F) and the one lying furthest to the rear (16).

13. Convertible vehicle according to Claim 12,
characterized in that

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in each case symmetrically to one vertical vehicle longitudinal center plane (21), two longitudinal guiding projections (27; 28; 29) and two longitudinal guiding aids (23; 24; 25) are assigned to each transverse hoop (13; 14; 15), except for the farthest toward the front (12) and the farthest toward the rear (16) with respect to vehicle driving direction (F).

14. Convertible vehicle according to one of Claims 1 to 13,
characterized in that
on each transverse hoop (13; 14; 15) provided with at least one longitudinal guiding aid (23; 24; 25) and at least one longitudinal guiding projection (27; 28; 29), the longitudinal guiding aid (23; 24; 25) and the longitudinal guiding projection (27; 28; 29) lie immediately adjacent to each other in vehicle transverse direction.

15. Convertible vehicle according to one of Claims 1 to 14,
characterized in that
it comprises a rigid rear roof part (4) surrounding a rear window (5) on which the flexible roof area (10) follows in driving direction (F) when the roof (3) is closed.

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16. Convertible vehicle according to Claim 15,

characterized in that

the rear roof part (4) can be lowered into the body (6) during the shortening of the flexible roof area (10).